Research and Reviews: Journal of Medicinal Chemistry

Tulsi: An elixir for human life

Pranay Kumar Gupta[1]*, Siddarth Pulapalli[1], Srikanth[1]

Department of Biotechnology, Aurora's Technological and Research Institute, Hyderabad, Telangana, India.

Commentary

Received: 16/02/2015
Accepted: 24/03/2015
Published: 30/03/2015

*For Correspondence
Pranay Kumar Gupta, Department of Biotechnology, Aurora's Technological and Research Institute, Hyderabad, Telangana, India.

Keywords: Alkaloids, Flavonoids, Terpenoids, Secondary metabolites, Phytochemical Compounds, UV filtration.

INTRODUCTION

Alkaloids, Flavonoids and Terpenoids are secondary metabolites. Alkaloids are mainly involved in plant defensive mechanism against herbivores and pathogens [1]. Secondary metabolite, "Alkaloids" is the nitrogenous compounds and it is found in 20% of the plant species [2]. Biosynthesis of secondary metabolites in plants is more complex compared with primary metabolism. Methyl jasmonate and salicylic acid are naturally occurring secondary metabolites in plants and these have the ability to regulate several plant physiological processes in response to pathogen attack and ozone gas [3]. Plants are the primary source of natural antioxidants.

Secondary metabolites are produced by beneficial fungi which have been isolated and characterized mostly from a genus trichoderma. Secondary metabolites are also called as Phytochemicals compounds [4,5]. In spite of the rich chemical diversity of marine cyanobacterial natural products, very little is known regarding their ecological functions. Certain benthic marine cyanobacterial strains are known to produce structurally diverse natural products in different concentrations [6].The extraction of secondary metabolites is done from Osimum (Tulsi) leaves from three different species Ocimum Sancium, Ocimum gratissimum and Ocimum tenuiflorum. These secondary metabolites are extracted from three species and estimated [7,8]. Alkaloids are extracted using column chromatography and estimated using ammonium hydroxide. Flavonoids are extracted by using soxlet apparatus and estimated using High Performance Liquid Chromatography (HPLC). Terpenoids are extracted by Linalool solution and estimated by calorimeter [9].

Alkaloids are the source of prevention of human and their foodstuffs from microorganism and fungus. Fungi are the destroyers of food which is stored and spoils the food by producing myotoxins [10]. All alkaloids which are present in Bulbus Fritillariae cirrhosae show anti-tussive effects. Positive and tested groups could exist but not yet developed [11]. These phytochemical substances are part of mechanisms in plant defense. All the types and amount of alkaloids change, it depends upon species, planting sites and environmental conditions [12]. Terpenes are also the secondary metabolites. The term terpenes are derived from turpentine and commonly present in higher plants as constituents of essential oils. Terpenoids are also called as isoprenoids which are large and diversified class of naturally-occurring organic chemicals. These are derived from five-carbon isoprene units assembled and modified in thousands of ways. Some insects also produce terpenes [13]. They are also major components of resin [14]. In plant kingdom, flavonoids are ubiquitous and very efficient anti-oxidants. Anti-oxidants are the chemicals that block the activity of other chemicals; these are known as free radicals. High Performance Liquid Chromatography (HPLC) is sensitive and simple method for separation of flavonoids from complex mixture [15]. Flavonoids are group of Polyphenols compounds, which are widely distributed in plant kingdom. Flavonoids are a group of nature phenolic compounds which plays an important role in cancer prevention and common characteristics C6-C3-C6 consists of two benzene rings. Flavonoids possess

anti-oxidation, anti-cancer, hepatoprotective, anti-inflammatory activities [16]. To date 3000 varieties of flavonoids are known. Many of flavonoids are widely used in medicine of maintenance of capillary integrity.

HISTORY

The term alkaloids or Pflanzenkalien was coined by Meissner, a German pharmacist, in 1819. These alkaloids are used for various purposes like poison, medicine, poultices, teas and many more. The French chemist, Derosne in 1803, isolated narcotine and in the same year morphine was isolated from opium by Serturner. Pelletier and caventon isolated emetine in1817 and colchicine in 1819. By 1884, about 25 alkaloids were reported to be isolated from cinachona bark alone. In 1973, the number of known alkaloids had reached up to 4959 and till date the number of alkaloids discovery has crossed 6000 in number.

The secondary metabolites in plants can be categorized based on their biosynthetic principles. Similarly, Terpenes are also having different types such as mono-terpenes, di-terpenes, tri-terpenes, sesqui- and tetra-terpenes, saponins, steroids, cardiac glycosides and sterols [17]. Since 1945, researchers witnessed an extensive explosion in natural product chemistry due to the advent of chromatography and spectroscopy techniques. The primary essential oils from the plants have considerable antioxidant and anti-inflammatory properties. Hydro distillation is considerable and common method for extracting natural and neat essential oils from plant material which is involved in some physicochemical processes like hydro diffusion, a method of extracting essential oils and hydrolysis is a chemical reaction in which chemical compounds reacts with water and separates into 2 or more compounds [18]. The more number of Terpenoids are described in the plant kingdom and many terpenes have their important biological activities. Most of the sesqui-terpenes and di-terpenes are used as antibiotics and some are insects and plant hormones respectively. Flavonoids inhibit certain types of cancer; dementia is a brain disease by which gradual decrease in the ability to think and remember; cardiovascular diseases such as heart attack and diabetes [19].Phytochemicals are known to play an important role in prevention of many major diseases. Flavonoids actually have a long and varied history. From past decade, people ingest flavonoids to improve heart health and many other diseases [20]. Some additional food contains flavonoids including chocolate and different type of tea leaves. Soy isoflavonoids plays an important role in prevention of cardiovascular diseases. The main cause of myocardial infarction and atherosclerosis is diabetes. Soybeans carry various compounds such as saponins and iso-flavones [21].

Role of Alkaloids, Terpenoids & Flavonoids in Plants:

Alkaloids are poisonous in nature. The exact role of alkaloids is still a topic ambiguity. Some of the roles have been predicted. When alkaloids are used in specific quantity; the physiological effect on animals and Homo sapiens has taken a secured place in medicine. Alkaloids are the reserve substance with an ability to supply nitrogen. Plants grown in dry region protects from grazing animals, herbivores and other insects due to the defensive mechanism involved by alkaloids. Alkaloids might be the possible way for growth of plants. Alkaloids act as a carrier with in plants for transportation of acids like meconic acid, cinchotannic acid and many more. Alkaloids may function as end product of detoxification mechanism in plants. By this way it locks up the metabolic compounds which are harmful for the growth of the plants.

Plants do not accumulate terpenes for herbivore defense, but also emit volatile blends in response to herbivores and many other biotic and abiotic stresses. The role of terpenes is signal in plant defense. Volatile terpenes released from the leaves of the maize plant after the attack of caterpillars. These are the natural enemies of the maize plant.

Flavonoids are widely distributed in plants. These are the most important pigments for flower coloration. In higher plants, flavonoids are involved in UV filtration, symbiotic fixation and flower pigmentation. In addition some flavonoids have inhibitory activity against organism that causes plant disease.

Role of phytochemical compounds in prevention of diseases:

Natural products have historically been a rich source of “lead compounds” for drug discovery. The bioactive compounds from sponges are classified as anti-inflammatory, antitumor, immuno or neuro-suppressive, antiviral, anti-malarial, anti-tuberculosis and antibiotic or antifouling, cytotoxic or cardiovascular properties, enzyme inhibitors, cell division-inhibitors [22]. Cancer is a life-threatening

disease that attacks all the people. It is an environmental disease which is related to lifestyle, environmental factors and also genetic factors [23].Polyphenols are the chemical class of flavonoids which are widely distributed in most of the plants and vegetables [24].Hypericum japonicum is an herb which is used to cure hepatitis in southern china for more than hundred years. As per modern investigation, it has been revealed that Hypericum japonicum is potent of anti-microbial, liver protection and anti-hypertension [25]. Flavonoids are mostly found in seeds, citrus fruits, olive oil and we can also find in red wine. Focal adhesion kinase (FAK) which is a protein found over expressed in numerous cancers and constitutes an important target for the design of antitumor inhibitors [26].

Analytical Methods used in Extraction and Estimation of the Secondary Metabolites:

Alkaloids are extracted by using the alcoholic solutions such as ethanol and methanol. These alkaloids are further purified by crystallization of the salts. Estimation is done by Thin Layer Chromatography [27].Absorption spectrometry is used for the extraction of Alkaloids and estimated from absorbance at 300 and 530 nm, respectively [28]. Flavonoids are extracted from the leaf material collected and washed under tap water, then cut into small pieces and dried at 40ºC in ventilated drying and using a Clevenger-type apparatus or soxlet apparatus, flavonoids can be extracted. Flavonoids are extracted from the coffee beans to obtain anti-influenza virus compounds. The extract is analyzed by using HPLC [29,30]. Terpenoids are extracted by hydro distillation of dried plant material using Clevenger-type apparatus for 3hours and the estimation is done by either calorimeter or by gas chromatography and chiral analysis is done to provide detailed characterization of the material [31,32].

CONCLUSION

Tulsi is considered as a medicinal plant and it is scientifically proven. Extraction of secondary metabolites by using traditional methods is a difficult process. Some of the problems which are reported are low yield and high cost of purification. In comparison to traditional extraction methods new extraction methods such as membrane separation technology, distillation and chromatography saves the time and energy and provides better outcome. It was observed that Osimum sancium carries high amount of alkaloids, Terpenoids and flavonoids compared to the other two different species.

Often we move forward in our life ignoring our past and lessons we have learnt from our ancient culture. Present day's science and technology is harvesting our past cultures to gain the lost knowledge with time once again. Throughout the globe there are several tribal cultures exists even now who applies traditional methodologies for healthcare and cure for certain diseases. Instead of ignoring, knowing them with our modern support of science and technology would be the best approach to know the medicinal properties of several known and unknown natural resources.

REFERENCES

1. http://www.weizmann.ac.il/plants/aharoni/PlantMetabolomeCourse/June192007.pdf.
2. Mazid M, et al. Role of secondary metabolites in defense mechanisms of plants. Biology and medicine. 2011;3:232-249.
3. Yin J, et al. The Physiological Characteristics, Expression of OxidosqualeneCyclase Genes and Accumulation of Triterpenoids in White Birch (Betulaplatyphyllasuk) Saplings by Sa and Meja Treatment. J Plant Biochem Physiol. 2014;2:2.
4. Singh S and AK Gupta. Evaluation of Phenolics Content, Flavonoids and Antioxidant activity of Curcuma amada (Mango Ginger) and Zingiberofficinale (Ginger). Journal of Chemistry. 2013;2:33.
5. Francesco Vinale. Biopesticides and Biofertilizers Based on Fungal Secondary Metabolites. J BiofertilBiopestici. 2014;5:e119.
6. Lik Tong Tan and Beverly Pi Lee Goh. Chemical Ecology of Marine Cyanobacterial Secondary Metabolites: A Mini-Review. J Coastal Dev. 2009
7. Enyiukwu DN, et al. Significance of characterization of secondary metabolites from extracts of higher plants in plant disease management. International journal of advance agricultural research. 2014;8-28.
8. Selvam K, et al. Antioxidant potential and secondary metabolites in Ocimum sanctum L. at various habitats. Journal of Medicinal Plants Research.2013;7:706-712.

9. Indumathi C, et al. Estimation of terpenoid content and its antimicrobial property in Enicostemmalitorrale. International Journal of ChemTech Research. 2014;6:4264-4267.
10. Vimalendra Mishra and Debajit Borah. PHYTOCHEMICAL AND ANTIMICROBIAL EFFECTS OF SOME INDIGENOUS MEDICINAL PLANTS. IJPAES. 2011;1-71.
11. Dongdong Wang, et al. Activities of Antitussive of even Alkaloids from BulbusFritillariaecirrhosae. Nat Prod Chem Res. 2014;2:S1-005.
12. EduarOrtegaDavid and Aida RodriguezStouvenel. Bioprocessing of Lupin Cotyledons (Lupinusmutabilis) with Rhizopusoligosporus for Reduction of Quinolizidine Alkaloids. J Food Process Technol. 2014;5: 323.
13. Tyagi A. Antimicrobial Potential and Chemical Characterization of Serbian Liverwort (Porellaarboris-vitae): SEM and TEM Observations. Evid Based Complementary Alternat Med. 2013.
14. Yermakov AI, et al. Characteristics of the GC-MS Mass Spectra of Terpenoids (C10H16). CSJ. 2010;1:1.
15. Shintani H. Determination of Flavonoids (Catechins) by HPLC-ECD. Pharm Anal Acta. 2013;4:5.
16. ChiMing Liu, et al. The Antioxidation and Antiproliferation Activity of New Flavonoids from the Leaves and Stems of CinnamomumreticulatumHayate. Med chem. 2015;5:064.
17. Freiesleben SH and Jaumlger AK. Correlation between Plant Secondary Metabolites and Their Antifungal Mechanisms–A Review. Med Aromat Plants. 2014;3:2.
18. Ololade ZS, et al. Recovered Secondary Metabolites of Post-HydrodistilledCallitriscolumellaris Leaf and their Free Radical Scavenging Potentials. Organic ChemCurr Res. 2013;2:1.
19. Paranthaman R, et al. GC-MS Analysis of Phytochemicals and Simultaneous Determination of Flavonoids in Amaranthuscaudatus (Sirukeerai) by RP-HPLC. J Anal Bioanal Techniques. 2012;3:5.
20. Tee LH, et al. Phytochemicals and Antioxidant Capacities from Dacryodesrostrata Fruits. Med chem. 2015;5:023.
21. MurlidharMeghwal and Chandan Kumar Sahu. Soy Isoflavonoids as Nutraceutical for Human Health: An Update. J Cell SciTher. 2015;6:194.
22. MasteriaYunovilsa Putra and IrwandiJaswir. The Alkaloids from Indonesian Marine Sponges. Oceanography. 2014;2:125.
23. Marawan M Shabana, et al.In Vitro and In Vivo Anticancer Activity of the Fruit Peels of Solanummelongena L. against Hepatocellular Carcinoma. J Carcinog Mutagen. 2013;4:149.
24. Tarun Kumar Dasgupta, et al.Spectroscopic & Chromatographic Methods for Quantitative Analysis of Phospholipid Complexes of Flavonoids A Comparative Study. Pharm Anal Acta. 2015;6:322.
25. Ning Wang, et al. The Bioavaliability of HepatoprotectiveFlavoniods in HypericumJaponicum Extract. JBBM. 2009;1-1.
26. Xuan Qin, et al. Synthesis, Molecular Modeling and Biological Evaluation of 7-Sulfanylflavone as Anticancer Agents. Med Chem. 2011;1:104.
27. Mohammed M, et al. Rubiothiazepine a Novel Unusual Cytotoxic Alkaloid from IxoraundulataRoxb. Leaves. Nat Prod Chem Res. 2014;2:128.
28. Hassan IA, et al. Investigation of Climate Changes on Metabolic Response of Plants: Interactive Effects of Drought Stress and Excess UV-B. J Earth Sci Climate Change. 2013;4: 1.
29. Rojas J, et al. Chemical Composition of HypericumlaricifoliumJuss. Essential Oil Collected from merida-Venezuela. Med Aromat Plants. 2013;2:5.
30. Kunihiro Kaihatsu, et al. Potential Anti-Influenza Virus Agents Based on Coffee Ingredients and Natural Flavonols. Nat Prod Chem Res. 2014;2:129.
31. Ramdani M, et al. Essential Oil Variability in Natural Hahadjerine Population of Cupressusdupreziana in Tassili n' Ajjer (Algeria). Forest Res. 2012;1:1.

32. VS Pragadheesh, et al. Leaf Essential Oil of Cultivated PimentaRacemosa (Mill.) J.W. Moore from North India: Distribution of Phenylpropanoids and Chiral Terpenoids. Med Aromat Plants. 2013;2:118.

1.